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Fig. 1.

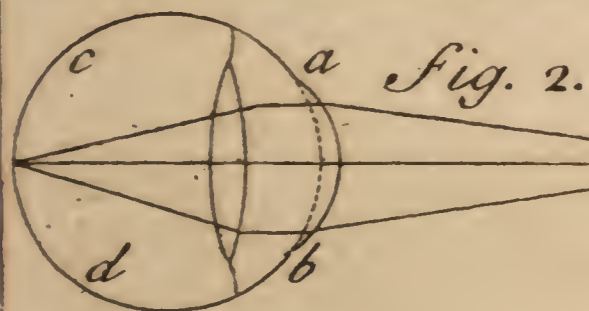


Fig. 2.

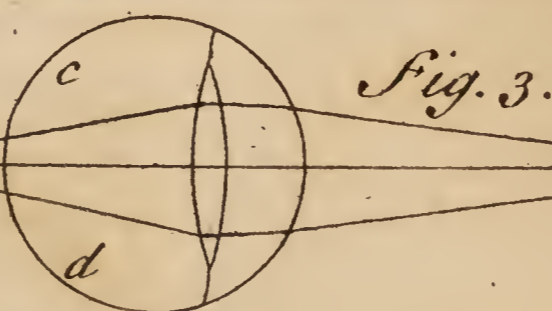


Fig. 3.

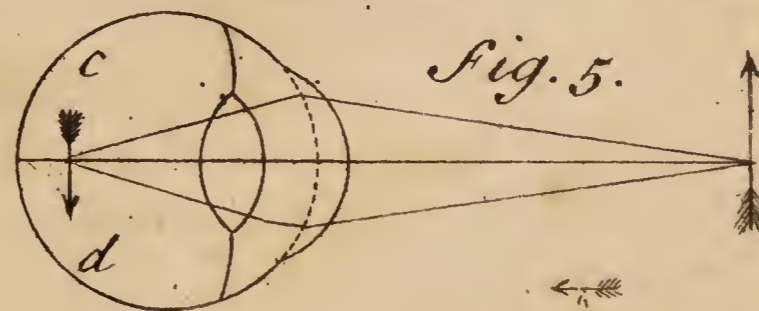


Fig. 5.



Fig. 6.

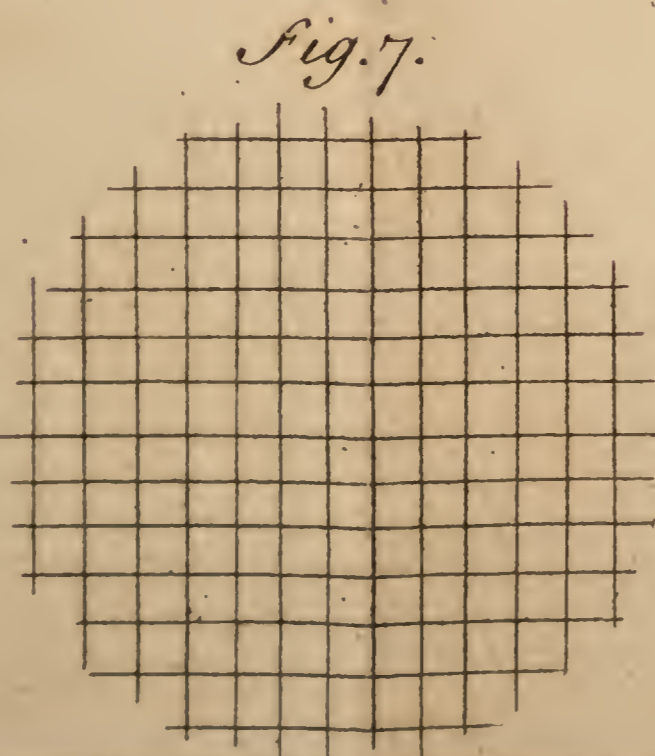


Fig. 7.

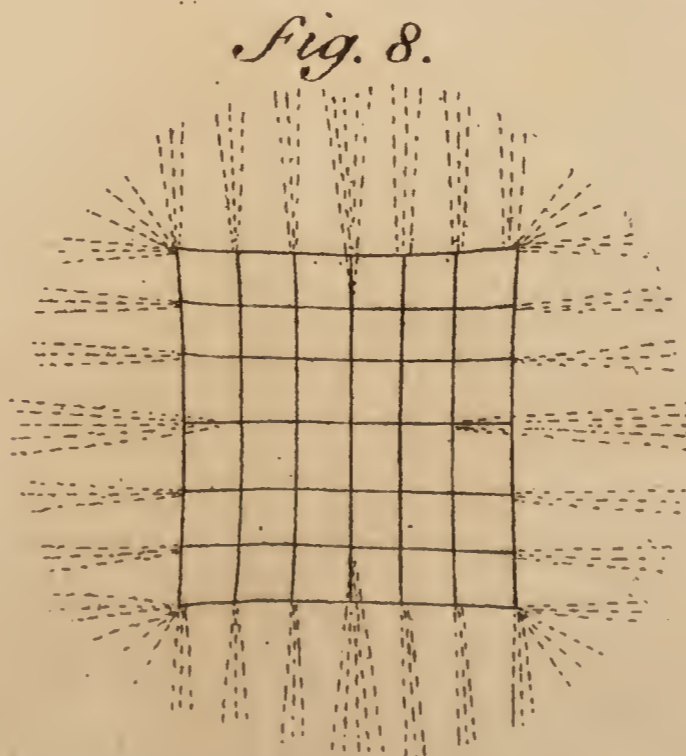


Fig. 8.

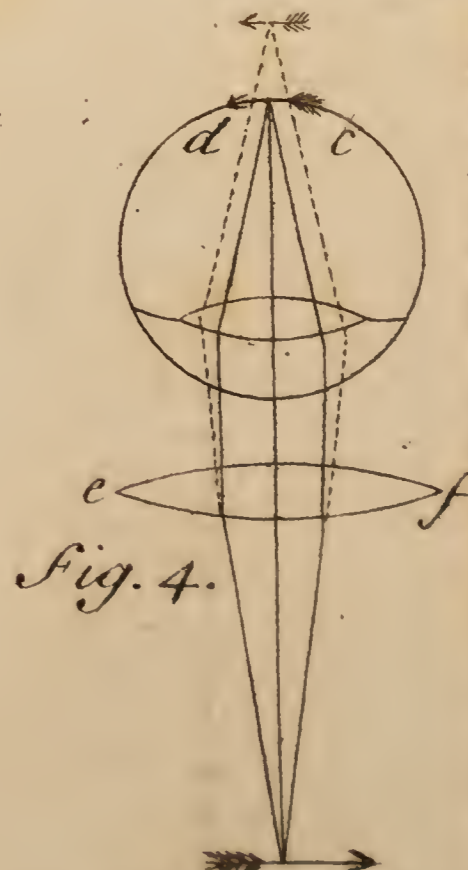


Fig. 4.

A SHORT
ACCOUNT
OF THE
EYE
AND
NATURE of VISION.

[Price Six Pence.]

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A SHORT
ACCOUNT
OF THE
EYE
AND
NATURE of VISION.

Chiefly designed to Illustrate the
USE and ADVANTAGE
OF
SPECTACLES.

WHEREIN
Are laid down Rules for chusing GLASSES
proper for remedying all the different
Defects of SIGHT.

AS ALSO
Some REASONS for preferring a particular
Kind of GLASS, fitter than any other made
Use of for that Purpose.

By *JAMES AYSCOUGH*, Optician.

The FOURTH EDITION.

L O N D O N:

Printed by E. SAY, for A. STRAHAN, in *Cornhill*; J. ROBINSON, *Ludgate-Street*; P. STEVENS, facing *Stationers-Hall*; and Mrs. DODD, without *Temple-Bar*. MDCCCLV.



A SHORT
ACCOUNT
OF THE
EYE
AND
NATURE of VISION.

THE Design of the following Sheets being chiefly intended to illustrate the Use of Spectacles for helping defective Eyes, and to instruct People labouring under these Disadvantages how to judge of the Nature of their Infirmary, and learn them how to apply a proper Remedy; I shall therefore endeavour to write so, as to be understood by
B People

People of all Capacities, and shun all Terms of Art as much as possible.

As to the Nature of Vision, I shall not attempt to give any Account, how the Rays of Light proceeding from Objects, and conveyed through the Organ of the Eye, are propagated into the Brain; nor pretend to say what Membrane is the Seat of that Sensation, nor how these Sensations are perceived; that being properly an Inquiry into the Faculties of the Soul, a Work too mighty for Man; which has baffled the Researches of the most acute; seeing all their Endeavours to explain, have served to puzzle more than convince, and their Conclusions, at last no better than bare Conjectures, prove, *That the Works of the Almighty are wonderful, and his Ways past finding out.*

Neither shall I attempt to give an anatomical Account of the Eye, as to the particular Muscles, the different Coats and Humours, that compose that wonderful Machine; but, only considering it as an Optical Instrument, compare it to one of human Invention, and thence propose to illustrate how the Images of external Objects are painted on the *Retina* or back Part of it, and shew how any Imperfections arising from a bad Form are to be helped by the means of proper Glasses.

When

When we look on the Eye as an Optical Instrument ; whether we consider its external or internal Parts, its Motion, Size, or Situation, it is all Admiration ! Look on the Eyelids, how admirably they are contrived for the Defence, as well as the Ease of that glorious Machine ; serving as a Screen to shut out the Light, while the Soul lies asleep, without which it must have been always kept on the Bend, and useless Images formed on the *Retina*, without producing any Sensation ! How curiously their Edges are bound about with fine Cartilages, which serve to strengthen, as well as enable them to shut the closer ; and these again fortified with a Row of stiff Hairs, judiciously turned different Ways, to warn the Approach of Dangers, and also by their Interposition (like a dark Glass) moderate too excessive Light, while they admit as much as is necessary to show the Object distinctly !

If we examine the Coats and Humours, we shall find them still as wonderful in their Contexture, as admirably placed, and as curiously adapted to the Place and Business they are to perform : The delicate Transparency of the *Cornea*, so formed as to make the Light fall properly on the CrySTALLINE, so as to be collected by it on the *Retina*. A Lens

no less curious in its Formation, than wonderful in its constituent Parts; which, as Mr. *Leeuwenhoek* has made appear, consists of a vast Number of thin Plates and Scales lying one upon another, and every one of these made up of one single Fibre or finest Thread, wound in a most stupendous Manner, this Way and that Way, so as to run several Courses, and meet in as many Centers, and yet not interfere or cross one another in any one Place. The Aqueous and Vitreous Humours furnish equal Astonishment, tending to minister in a like wonderful Manner to the Perfection of this noble Machine, by keeping the whole extended to its proper Form, as well as assisting it in its refractive Powers; at the same Time they easily yield to a Change of its Figure, and the Motion of the Crystalline backward and forward, in adapting itself to see at different Distances,

The Provision that the admirable Artist has made for the Preservation of this perfectly well formed Organ, is every where proportioned to the Use and Excellency of it, and the inward Texture delicate and tender, in Proportion to their tender and curious Purposes. How judiciously is the Inside darkened that it may not reflect or disturb the Rays! and how wonderful does the Aperture of the *Iris* adjust itself to every diffe-

different Degree of Light ! When we consider, that this Instrument performs all these Things of itself, from the Nature of its Formation, without any Direction or Assistance from the Mind ; how must we be struck with Astonishment, and necessarily convinced, that such a Superstructure can be no other than the Work of an infinitely skilful Workman, where every Circumstance conspires to a Demonstration, that the noblest Works of human Invention are no more to be compared to the smallest Appendage of this most curious Minutia, than divine Perfection to finite Ignorance and Impotence !

Such is the Organ of the first, the noblest, the most elegant of all our Senses : It is on the *Retina* that are painted all the Glories of the Heavens, and Beauties of this lower World ; it is by Means of this Organ we contemplate the stupendous Works of its Creator, every where extended round us in the Firmament ; and through it we admire the Immensity of his Skill in the Formation of the minutest Thing that exists. From this Sense we receive the greatest Entertainment, the highest Delight ; and without it most of our other Faculties would in a great Measure be rendered useless. An Animal endued with Life and Motion, without Sight, how could he judge to advance

vance this, or retire that Way, to enjoy any useful, agreeable, or pleasant Object ; or shun a nauseous, or disagreeable Stumbling-block that lay in his Way ? How could the Race of Men search after Food, plough the Depth in quest of Knowledge, Riches, or even Luxury ? Or, in a State of Blindness, how could they shun Ten Thousand Dangers, that always every where surround them ?

The Use of this Sense, the Benefit of which we experience every Moment, needs be no farther insisted on, since the Loss of it is always accounted amongst the greatest of our Misfortunes ; and as Ignorance is reckoned the Blindness of the Soul, so utter Darkness, in a figurative Sense, is declared to be the Portion of those who shall never see God. How thankful then ought those to be, who enjoy in full Perfection this inestimable Blessing ? And how much to be commiserated are they, who either from natural Defects, or Decays through Age or Diseases, partake of some Degree of Blindness ? An Attempt therefore of this Kind will be easily excused, and candidly received, by all those who wish well to their Fellow-Creatures.

As I do not write this for the Instruction of Philosophers, Anatomists, or Opticians, who may understand these Things better than I pretend to do ; but for the general Use and Advantage of those who have not had the Opportunity from their Education to know the Laws of Refraction from the Rules of Opticks ; it will therefore be necessary to premise some Things here.

The Rays of Light proceeding from any luminous, or illuminated Body, diverge, in all Directions, in straight Lines.

From the Rules of Opticks it is demonstrated, that, in order to form an Image, these diverging Rays must be collected again into Points.

That the Rays of Light passing through any Medium, and falling on any diaphanous Body (as Glafs, &c.) of a denser Nature, are bent or crooked, and take another Direction, and *vice versa*.

That Rays from any Body falling on Glafs, &c. made into a globular or convex Form, (such as a common magnifying Glafs) are bent so as to meet in a Point behind it; which
Point

Point is called its Focus, and at that Place there is always an Image formed.

Every Eye has a Focus, either in or beyond it, where the Images of all external Objects are formed by its refracting Power.

From what has been said, the Nature of Vision, and Use of Spectacles, will be most easily explained by the common Experiment of the Dark Chamber, or, as it is usually called, the *Camera Obscura*; which is this: In the Room that is darkened, let a Hole be made in the Door or Window-Shutter, in which Hole place a Convex Lens (or common magnifying Glass); then holding a Sheet of white Paper within the Room, at a proper Distance from the Hole (which will be found by Trial) you will see on the Paper the Pictures of all external Objects, in their just Proportions and proper Colours, only they will be upside down, as in Fig. I.

If the Paper remain in the same Place, and in the room of the aforesaid Glass or Lens one that is flatter be used, the Picture upon the white Paper will then be confused; but by placing a Convex Spectacle-Glass before the Lens of a due Convexity, the Image on the Paper will again be rendered distinct. If a more Convex Lens than

the first be used, the Image on the Paper will again be confused; but may be rendered distinct, by placing in this Case a Concave Spectacle-Glass before the Lens.

The Reason of the indistinct Picture in these Cases, is, when the flatter Glass is used, the Rays passing through it are not enough refracted (or bent) but would meet at Points beyond the Paper; and in the other Case are too much bent, so as to meet too soon, and short of the Paper. The Paper being fixed, that Distance is not the proper Focus of any of these Lenses; but the Image is rendered distinct, as in the Experiment, by the Help of proper Glasses.

This Experiment represents the Manner of Vision by the Eye; for the *Cornea*, or outside Coat, being of a Convex Form, as *a b*, Fig. II. resembles the Lens placed in the Hole in the Window-Shutter; and on the Concavity of the Bottom of the Eye *cd* is expanded a fine Membrane called the *Retina*, which resembles the white Paper: On this Membrane the Pictures of all external Objects are formed. When the Pictures are formed distinct on the *Retina*, then the Objects appear clear and distinct; if the Pictures on the *Retina* are confused, then the Objects appear hazy and confused. This is con-

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firmed

firmed by taking off from the Bottom of the Eye the outward Coat called the *Dura Mater*, and applying a Piece of thin Paper in place of it, for we can then see Pictures of Objects lively painted on it: And according as these Pictures are perfect or imperfect, the Objects are seen perfectly or imperfectly; but if the Eye be tinged with any Colour (as in the Disease of the Jaundice) so as to affect the Pictures in the Bottom of the Eye with that Colour, then all Objects appear of the same Teint.

From hence we may easily see the Use of Spectacles; for, when the Eye is of a proper Convexity or Roundness, Rays from any external Objects falling upon it will be collected on the *Retina*, and form a distinct Image there, as is represented in Fig. II. But if, from the original Form, or through the Decay of the Humours by Diseases, or Old-Age, the Eye be of too flat a Figure, the Rays will not be refracted enough, but bent so as to meet at a Point beyond the *Retina*, as in Fig. III. This Defect (as in the Experiment) is helped by the Interposition of a Spectacle-Glass, *ef*, Fig. IV. which bends the Rays a little before they fall on the Eye, and giving it less to do, are then collected properly on the *Retina*; whereas, without the Help of that Glass, they would have proceeded

Objects: In the former Case we flatten the Eye a little, and in the latter we draw it up into a more Convex Form, to see distinctly: In Time the Eye will acquire either Conformation, and retain a fixed Form, too flat or too globular for Objects at a moderate Distance.

This is confirmed every Day, in the Case of Engravers, Watchmakers, Chasers, &c. who, by frequently forcing their Eyes into too Convex a Figure in order to see minute Objects, at last have their Eyes settled to that Configuration, and so become short-sighted, especially if they are used to these Employments when young, while the Coats of the Eye are tender and pliable.

On the contrary, Sailors and Husbandmen, by looking mostly at distant Objects, are rarely, if ever, short-sighted, and soon want the Assistance of Convex Glasses; because, by adapting the Eye to see remote Objects, it fixes at last in a Shape too flat for near Distances.

From hence we may see, that the Defects of the Eye will likewise alter by Habit, and even that these Defects may be remedied by Habit; and, according as People accustom themselves to such Habits, they may either increase or diminish these Defects. Age in
general

general alters the Form of the Eye, making the Eyes of most People grow flatter ; but the Form of the Eye may be likewise flattened, by using Glasses of too great magnifying Power, which will reduce the Eye to as flat a Figure, as either Old-Age itself, or looking at distant Objects : On which Account no Person should ever use Glasses that magnify more than what is absolutely necessary to remedy the Defect for which they have Recourse to that Help : For, though they can see to read, by bringing the Paper nearer to the Eye, yet it must strain it into such a Figure, so as afterwards they can never see without such Glasses. This I mention the rather, as many People think the chief Property of Spectacles consists in making the Object appear very big ; which is a great Error, and of worse Consequence than Glasses that do not magnify sufficiently to supply the Purpose. Notwithstanding what has been said, purblind Persons seldom find any considerable Alteration in their Eyes ; and I have even observed, contrary to the general Rule, that they sometimes grow rather more short-sighted.

Since therefore the Defects of the Eye, and the Glasses proper to remedy those Defects, vary so much, I shall now shew how People may judge when there is a Necessity to
 apply

apply to these Helps, and also lay down some Rules by which every one may chuse, not only good Glasses in their Kind, but such too, as are best suited to the Form and Shape of their own Eyes.

Every good Eye has one certain Distance (or nearly so) of seeing a common Size Print to read with Ease; and when the Eye begins to grow so flat, as to require the Assistance of Spectacles, they will find themselves obliged to hold a Book at a greater Distance; and they may observe also, when they read, write, or work any long Time, a Sort of Dizziness like a Cobweb will appear before their Eyes; and likewise, if they read by Candlelight, they will find it necessary to hold the Paper behind it.

These are the Signs of the Want of Spectacles; and whenever this appears to be the Case, no Person should be without them; for the endeavouring to see what they cannot without great Difficulty, strains and weakens the Eye, and by this they may receive more Injury in a Month or two, than they would otherwise do in as many Years, with the Assistance of proper Glasses, which would not only assist the Eye, but render Vision easy and pleasant.

In order therefore to make a proper Choice of Spectacles, that is, to judge what Glasses are of a due Degree of Convexity or Concavity, so as to assist the Eye properly for its refractive Power, hold a small Print at the Distance at which you was used to see distinctly when your Eyes were good, which with most People is about Ten or Twelve Inches; then chuse a Pair of Spectacles of such a Degree of Convexity, as renders the Letters as plain as they used to appear before your Sight was defective: If you chuse them too young, *i. e.* not Convex enough, they will scarce remedy the Defect; and you will not see distinctly, unless the Print is so far off, that the Letter will appear rather too small to be read. If you chuse them too old, *i. e.* too Convex, you will then be obliged to flatten the Eye to compensate their over-great Convexity, and thereby be in Danger of increasing the Defect.

For short-sighted Persons, the best Way is to look through a Concave Lens at some distant Object; and the least Concave of all the Glasses, through which you can see distinctly, is the best.

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These Trials always ought to be made where you can have the greatest Choice of Glasses : But those who live in the Country, at too remote a Distance from that Convenience, may be fitted by the following Method, *viz.* let the Person take a common Print, and move it to and from the Eye, till he sees distinctly, then measure exactly that Distance; (from the Eye to the Paper) and by sending an Account thereof to a proper Workman, they may be fitted to a sufficient Degree of Exactness.

But, as in many curious Pieces of Workmanship there is an absolute Necessity of viewing the Object under a large Angle, in order that the most minute Parts may be observed ; in this Case, Glasses of a larger magnifying Power, than what is proper for common Purposes, must be used ; and if the Work be brought nearer to the Eye, its Form will not be much altered ; but the shorter Time these Objects are viewed the better, for Reasons before given.

Now we have spoke of the Nature of the Disease, and the Remedy ; we have pointed out the Symptoms, and directed how to apply the Medicine : But, as in Physick the Quantum must be proportioned to the Quality

lity of the Drug, and altered according as it is good or bad of its Kind; so here the Glasses may be very judiciously chosen, as to their Degree of magnifying Power, and still they may be very bad Spectacles; for altho' they may assist the Eye in some Measure, as to its refractive Quality, yet they will insensibly hurt it in a greater Degree in several other Cases: Therefore we shall now proceed to speak of the Properties of the Glasses themselves, and detect whether the Fault lies in the Materials, or is owing to the Artist; and give such Rules, as every Person may chuse, examine, and judge for themselves; which were formerly known only to Connoisseurs and Workmen.

In speaking of the Imperfections, we shall have an Opportunity of observing the Properties of good Glasses, and point them out as we go along.

The Imperfections of Glasses are either owing to the Artist, or the Materials they are made of: The Workmen often through Hurry, Carelessness, or Want of Skill, put them out of their Hands of an untrue Figure or very bad Polish, and yet in such a Manner as not to be discovered but by very good Judges; whereas good Glasses ought to

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be

be very truly formed, and as exquisitely polished.

The Errors that arise from the Materials are often owing to a vast Number of Veins in it; but particularly, to an offensive glaring Light, occasioned by the Colour of the Glass [commonly made Use of for that Purpose]; so we shall speak to all these Points separately. And first,

To examine the Figure, view any common Print through the Spectacles, holding the Glass at a good Distance from the Eye, and removing it gradually from the Paper, if the Glass be of a true Figure, the Print or Object will all appear confused at the same Time; but if false, it will appear distorted about the Edges of the Glass, while it remains distinct in the Middle. Thus if you view cross Lines, which form small Squares, as in Fig. VII. through a true-ground Glass, it will appear perfectly like the Original, only bigger and bigger as you gradually remove the Glass, till you come beyond its Focus, where all Parts will appear indistinct together: Whereas, through a Glass not truly ground, the Squares in the Middle will appear with straight Sides, but those near the Edges crooked, of different Bigness, and confused, as in Fig. VIII.

To

To discover the Veins in Convex Glasses, place a Candle from you about the Distance of five or six Yards, then looking through the Glass, move it from the Eye, till you find it full of Light, and then will be seen every Vein and Speck in it. These Veins always distort Objects ; but Specks, which are only opake Spots, intercept but an inconsiderable Part of the Light, doing no other Damage. At the same time you will easily see if there be any Fault in the Polish.

As to the Colour, it has been found that the common white Glass gives an offensive glaring Light, very prejudicial to the Eyes ; and on that Account green and blue Glass have been advised, though they make every Object appear with their own Hue ; for these Reasons, that white Bodies in general, and all Objects strongly illuminated, are more painful to look upon than Objects tinged with these Colours.

With what more Ease and Pleasure do we view the azure Sky at the Dawn, or the green Fields in the Spring, than the Earth covered with Snow, and illuminated by the Noon-day Sun ?

But Experience teaches us, the finest Theories are liable to Objections, and must never be fully admitted till confirmed by Practice ; so Glasses of these Colours have been found ineffectual, excepting in Cases where the natural Defect of the Eye requires such ; or for Workmen looking on luminous Objects, to whom they are of very great Service, rendering those Objects easy to be viewed ; but to others are very prejudicial, making the Objects too dark through the Deepness of the Tinge of the Glass, and even affecting the Eye in such a Manner, that all Objects appear of the same Tinct for some Time after they are used.

Upon these Considerations, some Time ago I was induced to make Trial of a new Kind of Glass, and recommend it to the Publick, as being fitter for the Purposes of Spectacles than any other Sort whatsoever ; on these Accounts, it is harder, freer from Veins, and, being of a greenish Cast, takes off the glaring Light so much complained of in the White, yet so transparent as not to be liable to the Objections so justly made to those of deeper Colours.

That it is harder, is evident from the Difficulty there is in working it ; since Artificers
can

can grind near double the Number of white Glafs, that they can do of this Sort, in the fame Time: And as every one the leaft converfant in Opticks knows the greateft Exactness in Figure is requisite to make a good Object-Glafs in a long Telescope; so that this Sort makes excellent Glaffes for that Purpose is now known by the Experience of all Workmen, while it is impossible to make a tolerable good one out of the white Glafs.

It is likewise known, that a hard Body of a homogeneous Nature can be formed into a truer Figure, than one of a soft unequal Substance; where the softer Parts, in forming or polishing, always work away faster than the hard, and by that Means leave an unequal Surface. Such a Substance can never answer in great Telescopes, where every Error in the Image formed by the Object-Glafs is so greatly magnified by that next the Eye. From hence it appears, that the white Glafs is not only of a softer Body, but of a more heterogeneous Nature, and at the same Time is a Proof of the Hardness and equal Solidity of the Kind recommended.

That it is freer from Veins, we are certain from Examination; for in comparing any Number with the white Glasses, as directed

Page 19, you will find ten in the White full of Veins to one of these; and likewise the Veins in this Glass are so small in Comparison of the other, that the Errors arising from them must be less in Proportion.

That these Spectacles must be dearer, will appear from the greater Charge arising from the working, as well as from the higher Price of the Materials; but, their being so much preferable in every Shape to the common Glass, which Experience and the universal Approbation they have met with sufficiently confirms, makes them cheaper upon the whole, since the Difference of the Price is such a Trifle in Comparison to their superior Qualifications.

Notwithstanding the Opposition that was made to this Sort of Glass, some time since, by a few People of the Trade, yet some of the most violent of these Opposers are now so much convinced of the superior Excellency of it, that they themselves make Use of it for the same Purposes.

Even at that Time, some of them acknowledged the Properties of this Glass, though they opposed it in Publick (like the *Ephesian* Goldsmiths, who raised a Clamour
against

against Christianity, lest it should hurt the Craft, by destroying that lucrative Business of Shrine-making) giving it as a Reason, that it would spoil the Sale of Spectacles made of *Rock Crystal* and *Brazil Pebbles*, which for some Time had been much cried up for their extraordinary Virtues, while, in reality, there is nothing to recommend them but their exorbitant Price, and the no small Gain which they brought to the Craftsmen.

For, though they are hard, and take a fine Polish, they have a glaring Whiteness, and a Grain like the Island Crystal, and like that too a double Refraction*; and, as was observed before of the White Glass, it is impossible with these Substances to make Lenses either for Telescopes or Microscopes; and consequently can never be good Spectacles, though their Faults may not be so easily discovered in so simple an Instrument.

Upon the whole, the Motive of recommending this Glass was no other than being fully convinced of its Properties from the above Reasons, nor was there any Pretence to an Invention; only, happening to be the lucky Discoverer, I thought it my Duty to communicate it to the Publick. Neither is it

* See Sir Isaac Newton's Opticks, Book III. Quere 25.

it true, that this Glafs was at all Times formerly used, and for the most ordinary Goods, as has been falsely insinuated, seeing the Price would not answer for the Glaffes sold by Pedlars and common Hawkers.

As the most beneficial Discoveries to human Life have often been the Work of Chance, and though very few Philosophical or Optical Instruments made of late, deserve the Name of Invention, yet there are Numbers of them that may be greatly improved; and he who does his best Endeavours, and communicates them freely, is at least Praise-worthy for his good Intentions, *especially on such a Subject*: So I shall conclude with the Words of Mr. *Molineux*:
 “ Were there no farther Use of *Dioptricks*,
 “ than the Invention of *Spectacles* for the
 “ Use of defective Eyes; whether they be
 “ those of *Old Men*, or those of *Purblind*
 “ *Men*; I should think the Advantage that
 “ Mankind receives thereby, inferior to no
 “ other Benefit whatsoever, not absolutely
 “ requisite to the Support of Life. For as
 “ the Sight is the most noble and extensive
 “ of all our Senses; and as we make the
 “ most frequent and constant Use of our
 “ Eyes in all the Actions and Concerns of
 “ human Life; surely that Instrument that
 “ relieves

“relieves the Eyes when decayed, and sup-
 “plies their Defects, rendering them useful,
 “when otherwise almost useleſs, muſt needs,
 “of all others, be eſteemed of the greateſt
 “Advantage. In what a miſerable Condition
 “do we count thoſe, in whom it hath pleaſed
 “the *great Contriver of the Eyes and Sight*
 “to ſhut theſe two little Windows of the
 “Soul? And we may imagine, that they, in
 “whom theſe Lights are but *partly* obſcu-
 “red, do in ſome Meaſure partake of the
 “Miſeries of the Blind. How melancholy
 “is the *Condition* of him, who only enjoys
 “the Sight of what is immediately about
 “him? With what Diſadvantage is he enga-
 “ged in moſt of the Concerns of human
 “Life? Reading is to him troubleſome,
 “War more than ordinary dangerous, Trade
 “and Commerce toilsome and unpleaſant:
 “And ſo likewise, on the other hand, how
 “forlorn would the latter Part of moſt Men’s
 “Lives prove, unleſs Spectacles were at
 “hand to help our Eyes, and a little form-
 “ed Piece of Glaſs ſupplied the Defects of
 “Nature? The curious Mechanic, engaged
 “in any minute Works, could no longer
 “follow his Trade than till the Fiftieth or
 “Sixtieth Year of his Age; the Scholar no
 “longer converſe with his Books, or with
 “an abſent Friend in a Letter: All after
 E “ would

“ would be melancholy Idleness, or he must
 “ content himself to use another Man’s Eyes
 “ for every Line. Thus forlorn was the
 “ State of most *Old Men*, and many *Young*,
 “ before this admirable Invention ; which,
 “ on this very Account, can never be prized
 “ too highly.”

F I N I S.

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drant, in Ludgate-Street, LONDON,

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fracting

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